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Materiel Test Procedure 6-3-517
U. S. Army Airborne, Electronics and
Special Warfare Board

U. S. ARMY TEST AND EVALUATION COMMAND
COMMON SERVICE TEST PROCEDURE

ELECTRICAL POWER REQUIREMENTS

1. OBJECTIVE

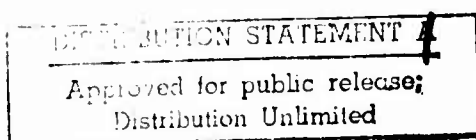
This document provides test methods and techniques to determine: communication-electronic equipment power requirements; if communication-electronic equipment meets specified performance criteria when operated with designated power source(s); and if newly developed power sources for communication-electronic equipment are suitable for intended purposes.

2. BACKGROUND

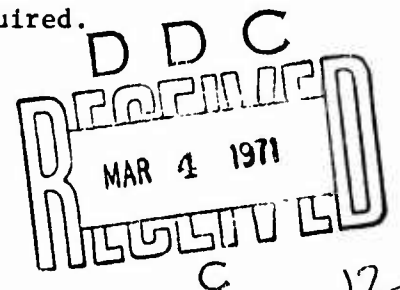
Many items of tactical communication-electronic equipment are required to operate from various types of power sources. Principal power sources include: integral or organic and separate batteries, both primary (expendable) and secondary (rechargeable) types; vehicular electrical systems of normal capacity and high capacity; engine generator sets both DC and AC types, the latter of which may be single phase, multiple phase, 60 or 400 Hz and have, collectively, nominal voltages of 115, 110-220, and 120-208; and lastly, such developmental types as fuel cells and thermo-electric generators. The use of such power sources often requires separate intermediate items such as a converter, inverter or power supply unit (power pack). However, the capability of these intermediate items may sometimes be provided, wholly or in part, within an item of communication-electronic equipment. Suitability testing is therefore required to determine: operability of communication-electronic items with various power sources; capabilities of intermediate items; and capabilities of power sources designed for communication-electronic applications. During such testing the tactical implications of power source capacity, power demands, time of operation (continuous-intermittent), battery life, changing time, charge-discharge cycles, noise, and resupply must be addressed as appropriate.

3. REQUIRED EQUIPMENT

- a. Equipment under test (test item). This may be a developmental communication-electronic item, power source or intermediate item.
- b. Equipment with which the test item is designed to operate (support item(s)).
- c. Tools/test equipment required to provide for proper operation of support item(s).
- d. Suitable test sites.
- e. Elapsed time meters.
- f. AC and DC voltmeters and ammeters as required.
- g. Test Set Electric Power AN/UPM-93.
- h. Test Set Electric Power AN/UPM-100.



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- i. Battery Test Set TS-183/U.
- j. Battery Test Set AN/PSM-13.
- k. Storage Oscilloscope with photographic recording means.
- l. Variable-voltage, variable-frequency power source.
- m. Regulated DC power supply.
- n. Manual Meteorological Measuring Station AN/PMQ-4.
- o. Still and motion picture cameras and film.
- p. Required equipment as listed in referenced MTP's.

4.

REFERENCES

- A. USATECOM Regulation 70-23, Equipment Performance Reports (EPRs).
- B. USATECOM Regulation 70-24, Research and Development: Documenting Test Plans and Reports.
- C. Technical Manuals and all other operating instructions provided for the test and support items.
- D. QMR, SDR or other approved requirements.
- E. Engineering test reports as available.
- F. MTP 6-3-502, Personnel Training and Requirements.
- G. MTP 6-3-512, Compatibility With Related Equipment.
- H. MTP 6-3-513, Qualitative Electromagnetic Interference.
- I. MTP 6-3-523, Safety.

5.

SCOPE

Electrical power requirements for communication-electronic equipment are determined through service testing conducted under field conditions by personnel representative of those who will be involved in actual combat operations. The observations of test supervisory personnel together with any measurements taken are recorded. By means of interview and/or questionnaires, test personnel comments are obtained and correlated with measurement and photographic data. The collected data is then analyzed and evaluated. Tabulations, charts or other suitable means are employed, as applicable, to compare test results with approved requirements criteria. This test procedure is to be used as a guide in the preparation of test plans for equipment described by this document. It is recommended that existing military standard test procedures and test manuals supplied with the specific type of equipment also be used in preparation of test plans.

5.1

SUMMARY

5.1.1

Preparation for Test

This section provides guidance for test project planning and requirements for facilities and equipment, and instructions for test personnel familiarization.

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5.1.2 Test Conduct

This is performed in five areas as follows:

a. Communication-Electronic Equipment as Test Item - Procedures are given for measuring AC and/or DC requirements and for mission type operation using various sources (engine-generator sets, vehicle electrical systems, and batteries).

b. Communication-Electronic Power Sources as Test Item - These test procedures are concerned with determining suitability of a given power source for supplying power to various items of equipment.

c. Intermediate Items - This section contains test procedures for use where separate intermediate items such as inverters and converters are involved.

d. Qualitative Electromagnetic Interference - Procedures are given for determining the existence of any interference caused by power sources and related items.

e. Compatibility - Procedures are included for determining areas where lack of compatibility exists between power sources and equipment with which they are operated.

5.1.3 Test Data

This section details the raw data to be collected and recorded while completing the test procedures in paragraph 6.2, Test Conduct.

5.1.4 Data Reduction and Presentation

This section provides instructions for analyzing and evaluating the raw data and presenting the results.

5.2 LIMITATIONS

This procedure does not provide for testing to determine suitability of general purpose power sources, particularly engine generator sets.

Measurements and procedures contained in this MTP will not be conducted if the required test data is available in engineering test reports (ref 4E).

6. PROCEDURES

6.1. PREPARATION FOR TEST

6.1.1 The test project officer and other designated test personnel must:

a. Conduct a thorough study of stated requirements as contained

in QMR's, SDR's, the Test Directive, or other appropriate documents to insure that complete and suitable test criteria are selected.

b. Study thoroughly all instructional material received to determine electrical power characteristics.

c. Plan for and schedule test personnel with appropriate MOS, skill levels and background compatible with test objectives.

d. Determine all support items required. All items not immediately available must be requested or requisitioned and dates required established.

e. Review the listing of Required Equipment (paragraph 3). Based on this review, the items together with personnel required to operate them will be selected and scheduled.

6.1.2 Required Equipment/Facilities Setup

Test projects conducted at the established USAAESW Board test facility will normally require minimum preparation with respect to equipment and facilities setup. Major items required are usually readily available but scheduling and planning for use are required.

6.1.3 Test Personnel Training and Familiarization

a. Instruct supervisory test team members on general test objectives. Issue copies of all applicable technical manuals on equipment to be used during test. Include the following:

- 1) Information on proper use of all equipment involved.
- 2) Procedures to be followed in using the test item under various tactical field conditions.
- 3) Known hazards and safety precautions associated with test procedures and equipment. Review MTP 6-3-523 (ref 4I) paying particular attention to information on electrical power.
- 4) Test data collection.

b. Prior to conduct of procedures in this MTP, assure that all operators and other appropriate test personnel have been trained according to the procedures in MTP 6-3-502 (ref 4F).

6.2 TEST CONDUCT

Throughout the conduct of testing, assure that the test item and all support equipment directly involved are in proper operating condition. Technical characteristics such as receiver sensitivity, power output, and modulation must be within specified operating limits. Where engine-generator sets are involved, assure that specified types and quantities of lubricants, coolants and fuels are used, and that operation is conducted under proper conditions of cooling air and ventilation.

6.2.1 Communication-Electronic Equipment as Test Item

a. If the test item requires AC input power, connect it to the variable-voltage, variable-frequency power source after voltage and frequency have been adjusted to operating values specified for the test item. Operate the test item in each of its modes, in turn, and exercise completely all of its functions. During conduct of these operations perform the following:

- 1) Measure input voltage and current for each operational mode and function.
- 2) Vary input voltage and frequency throughout that range specified for proper test item operation. If no range is specified, vary the voltage $\pm 10\%$ and the frequency $\pm 5\%$. Note any evidence of unsatisfactory test item operation.

b. Following completion of the procedures in paragraph 6.2.1a., operate the test item under field conditions to perform the mission stated in the QMR or SDR. Operate the test item using each power source specified and operate for periods of time consistent with the required test item mission. Note any evidence of unsatisfactory test item performance during operation in its various modes and functions. For power sources requiring fuels and lubricants, note the rates of consumption as well as the frequency and extent of servicing required. For test item missions requiring continuous operation over extended or other periods of time, note the effects of power source switchover and/or downtime required for power source servicing.

c. If the test item required DC input power, connect it to a regulated power source, the output voltage of which has been adjusted to the operating value specified for the test item. Operate the test item in each of its modes, in turn, and exercise completely all of its functions. During conduct of these operations:

- 1) Measure input voltage and current for each operational mode and function.
- 2) Vary input voltage throughout the range specified for proper test item operation. If no range is specified and the test item is to be operated from military vehicular electrical systems of the nominal 24-28 voltage type, vary the voltage within the range of 20 to 30 volts. For test items requiring DC power at voltages higher than 24-28 volt type, vary the voltage $\pm 10\%$. Note any evidence of unsatisfactory test item operation.

d. Following completion of procedures in paragraph 6.2.1c., perform the procedures specified in paragraph 6.2.1b. Where operation from tactical vehicle electrical systems is required, perform the following:

- 1) With the vehicle running at a representative operating speed, operate the test item in its various modes and

functions. At the same time operate (also start and stop) each item of vehicular equipment that is furnished power by the vehicle electrical system. Note any adverse operational effects on the test item.

- 2) Stop the vehicle engine leaving the test item operating. Continue test item operation until evidence of unsatisfactory performance is encountered or the vehicle engine fails to start. Repeat this as necessary to determine time of satisfactory operation on the vehicle battery and at the same time retain engine start capability.
- 3) Start and stop the vehicle engine with the test item turned on.
- 4) During the conduct of procedures in paragraphs 6.2.1d. 1) and 3), use a storage oscilloscope and look for any voltage transients occurring at the test item power input terminals. For all observed transients that exceed a peak value of 30 volts, document each occurrence using photographic recording means to show actual peak voltage value and the time of duration.

e. Where the test item is operated from a battery or batteries, either primary or secondary, external or internal (to test item), perform the following:

- 1) Under field conditions operate the test item from the battery or batteries specified to perform the mission stated in the QMR or SDR.
- 2) Operate the test item performing all functions and in all modes provided with each battery used until evidence is encountered that test item performance is unsatisfactory. Install a new battery if primary type is used or a fully charged battery if secondary type is used. Measure the time of satisfactory performance provided by each primary battery or each fully charged secondary battery, as the case may be, used under field conditions.

NOTE: Time of satisfactory operation provided by batteries used with tactical radio sets is based on a transmit-to-receive ratio of 1:9. This means continued cycles of one minute transmitting followed by nine minutes receiving. Larger increments of time (e.g., 2 minutes transmit and 18 minutes receive) must not be used, since this would result in unrealistic time during which certain types of batteries could recuperate and show an erroneous total time for satisfactory operation.

- 3) If the test item is a tactical radio set, operate it on a transmit-receive ratio of 1:9 on each battery used until evidence of unsatisfactory performance has been

encountered. Measure the time of satisfactory performance provided by each battery used.

- 4) For all rechargeable type batteries used, measure the time in each instance, required for charging.

f. During the conduct of all procedures specified in paragraph 6.2.1, measure weather conditions, particularly temperature, prevailing during testing.

6.2.2 Communication-Electronic Power Source as Test Item

a. Under field conditions, operate the test item with each communication-electronic equipment or system with which it is designated to operate. Operate each equipment or system to perform all modes and functions provided. Operate for a period or periods of time consistent with mission(s) specified.

b. For each equipment or system operated with the test item, note any evidence of unsatisfactory equipment or system performance. If the test item requires fuels and lubricants, note the rates of consumption as well as the frequency and extent of servicing required for each equipment or system application.

c. Where the test item is a battery or batteries, perform the procedure in paragraph 6.2.2a., noting all evidence of unsatisfactory performance. Continue operation until lack of adequate power causes unsatisfactory operation of the equipment or system item. Install a new test item in case of primary battery types, or recharge in case of secondary battery types and continue operation. Measure the time of satisfactory performance provided in each instance. Where the test item is used with tactical radio sets, apply also the procedure of paragraph 6.2.1e. 3). Measure the time required for charging where the test item is a rechargeable type.

d. During the conduct of all procedures in paragraph 6.2.2, measure weather conditions, particularly temperature, prevailing during testing.

6.2.3 Intermediate Items

Supply of electrical power to tactical communication-electronic equipment may entail separate intermediate items such as converters or inverters. Where such items are involved, the basic procedures of paragraphs 6.2.2 and 6.2.3 will be applied. Additionally:

a. Total power required in each case must be measured both with and without the intermediate item in order that its efficiency may be indicated. (This is especially important where the power source is a manpack battery).

b. Particular attention must be given to voltage and/or frequency variation conditions. Intermediate items, particularly those employing solid state devices, may be incapable of satisfactory operation or completely cease operations at certain voltage limits that do not significantly affect equipment with which they are operated.

6.2.4 Qualitative Electromagnetic Interference

Perform applicable portions of MTP 6-3-513 (ref 4H) in order to determine the existence of any interference caused by power sources or intermediate items.

6.2.5 Compatibility

Using applicable procedures in MTP 6-3-512 (ref 4G) obtain data on compatibility (such as cables, connectors, size, and weight) of power source(s) and intermediate item(s) for use with related equipment.

6.3 TEST DATA

NOTE: In compiling the Test Data section, test personnel should expound upon those data which are other than quantitative in nature by recording narrative descriptions of events occurring during conduct of testing.

Record the following:

6.3.1 Communication-Electronic Equipment as Test Item

- a. Complete nomenclature and serial number(s) of test item.
- b. Input nominal voltage, current and frequency (as appropriate) for each mode of operation and/or function.
- c. AC and/or DC voltage limits for satisfactory operation.
- d. Frequency limits (as appropriate) for satisfactory operation.
- e. Complete nomenclature and serial number(s) of each power source used.
- f. Each instance of unsatisfactory operation encountered with each power source used.
- g. For engine generators and other power sources used requiring fuels and lubricants:
 - 1) Type fuel(s) used.
 - 2) Type lubricants used.
 - 3) Rates of fuel and lubricant consumption.
 - 4) Frequency and extent of servicing required together with time and personnel (MOS and numbers) required.
- h. Nomenclature and serial number of each vehicle the electrical system of which was used as a source of power.

- 1) Each instance of unsatisfactory operation encountered.
- 2) Length of time for satisfactory operation without vehicle engine running.
- 3) Each instance where a voltage transient exceeding 30 volts was encountered, the condition(s) under which it occurred, its peak value and its time of duration.

i. Nomenclature and serial number of each battery used.

- 1) Each instance of unsatisfactory performance encountered with each battery used.
- 2) Time of satisfactory performance for each battery used. (For rechargeable batteries this means the time of satisfactory operation for each fully charged battery).
- 3) For rechargeable batteries, the time required for charging in each instance and identity of the charging equipment used.
- 4) The total number of charge-discharge cycles to which each rechargeable battery was subjected and all servicing required.

j. Weather conditions, particularly temperature, under which testing was conducted.

6.3.2 Communication-Electronic Power Source as Test Item

a. Nomenclature and serial number of each equipment or system that was furnished power by the test item.

b. As appropriate, those items of data specified in paragraph 6.3.1. (This will depend on type of test item dealt with, i.e., engine generator, battery, fuel cell, thermo-electric, or other).

c. Weather conditions, particularly temperature, under which testing was conducted.

6.3.3 Intermediate Items

Basic data as specified in paragraph 6.3.1, as appropriate, depending on power sources and communication-electronic equipment involved. In all cases, record the following:

a. The power consumed by the intermediate item.

b. Perimeter limits for satisfactory operation, i.e., voltage and/or frequency as applicable.

6.3.4 Qualitative Electromagnetic Interference

Data required, as appropriate, by MTP 6-3-513 (ref 4H).

6.3.5 Compatibility

Data required, as appropriate, by MTP 6-3-512 (ref 4G).

6.4 DATA REDUCTION AND PRESENTATION

Organize, analyze and summarize the raw data specified in paragraph 6.3 including that of the MTP's cited. Use tabulations and charts as appropriate. Make a succinct and unbiased presentation of test data to show:

- a. The extent to which electrical power requirements (test criteria) as stated in QMR's, SDR's or other approved documents have been fulfilled.
- b. Deficiencies, shortcomings and suggested improvements as appropriate.

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